Addendum to Expanded Engineering Evaluation/Cost Analysis for the Bald Butte Millsite and Devon/Sterling and Albion Mine Sites Lewis & Clark County, Montana

Since the completion of the Expanded Engineering Evaluation/Cost Analysis (EEE/CA) for the Bald Butte Millsite and Devon/Sterling and Albion Mine Sites (aka Bald Butte Mine and Millsite) in December 2004, another potential location for a mine/mill waste repository has become available in conjunction with the Great Divide Tailings Site located near Marysville, Montana. Investigation and reclamation design activities at the Great Divide Tailings Site have been completed by the Bureau of Land Management (BLM). This addendum addresses the characterization of the additional repository site and the detailed analysis of this alternative, which is referred to as Alternative 8. The detailed analysis of Alternative 8 considers only the Bald Butte Mine and Millsite, with the exception that the preliminary repository design includes enough capacity to accommodate the anticipated waste volume from the Great Divide Tailings Site. By only including the Bald Butte Mine and Millsite in this evaluation, it will provide for a direct comparison with the alternatives from the original EEE/CA. Evaluation of the Great Divide Tailings Site is being completed separately by the BLM.

3.8 Potential Repository Site Investigations

Two potential repository locations have been identified for the Bald Butte Millsite. The first (Bald Butte Millsite Repository) was located and characterized as part of the Bald Butte Millsite characterization. The second repository (Bald Butte/Great Divide Repository) was characterized in 2008.

3.8.1 Bald Butte Millsite Repository

The Bald Butte Millsite and Devon/Sterling and Albion Mines are located in a steep, narrow and mountainous drainage basin. Land ownership in the project area is mostly private on patented mining claims, with some small parcels of public land between claims. Land ownership outside of the immediate project area is mostly public land. Based on the terrain and the ownership status, the potential areas for mine/mill waste repositories are limited. During the site characterization, a potential mine/mill waste repository site north of the Bald Butte Millsite area was investigated. This work involved assessing land ownership, estimating potential repository storage volume and preliminary design, construction logistics, and an evaluation of the subsurface geology and shallow groundwater.

Site characterization results indicate that the mill tailings and waste rock piles WR-1 through WR-4 probably represent the most significant source of contaminants for impacting human health and the environment. The total estimated volume of mill tailings associated with the Bald Butte Millsite is approximately 70,650 cubic yards. The estimated total volume of waste rock piles WR-1 through WR-4 is approximately 2,874 cubic yards. In addition, native soil beneath tailings piles TP-1, TP-2, TP-4/vat leach area, TP-5 and TP-6 appear to have been impacted by tailings. Assuming that a one foot layer of native soil is removed from these sources, the volume of impacted soil would be approximately 33,830 cubic yards. The Devon/Sterling and Albion waste rock pile WR1A exceeds TCLP regulatory limits for lead and WR3A is possibly acid generating. The combined volume of the Devon/Sterling and Albion waste rock piles is approximately 32,940 cubic yards. The combined volume of all these sources is approximately 140,300 cubic yards.

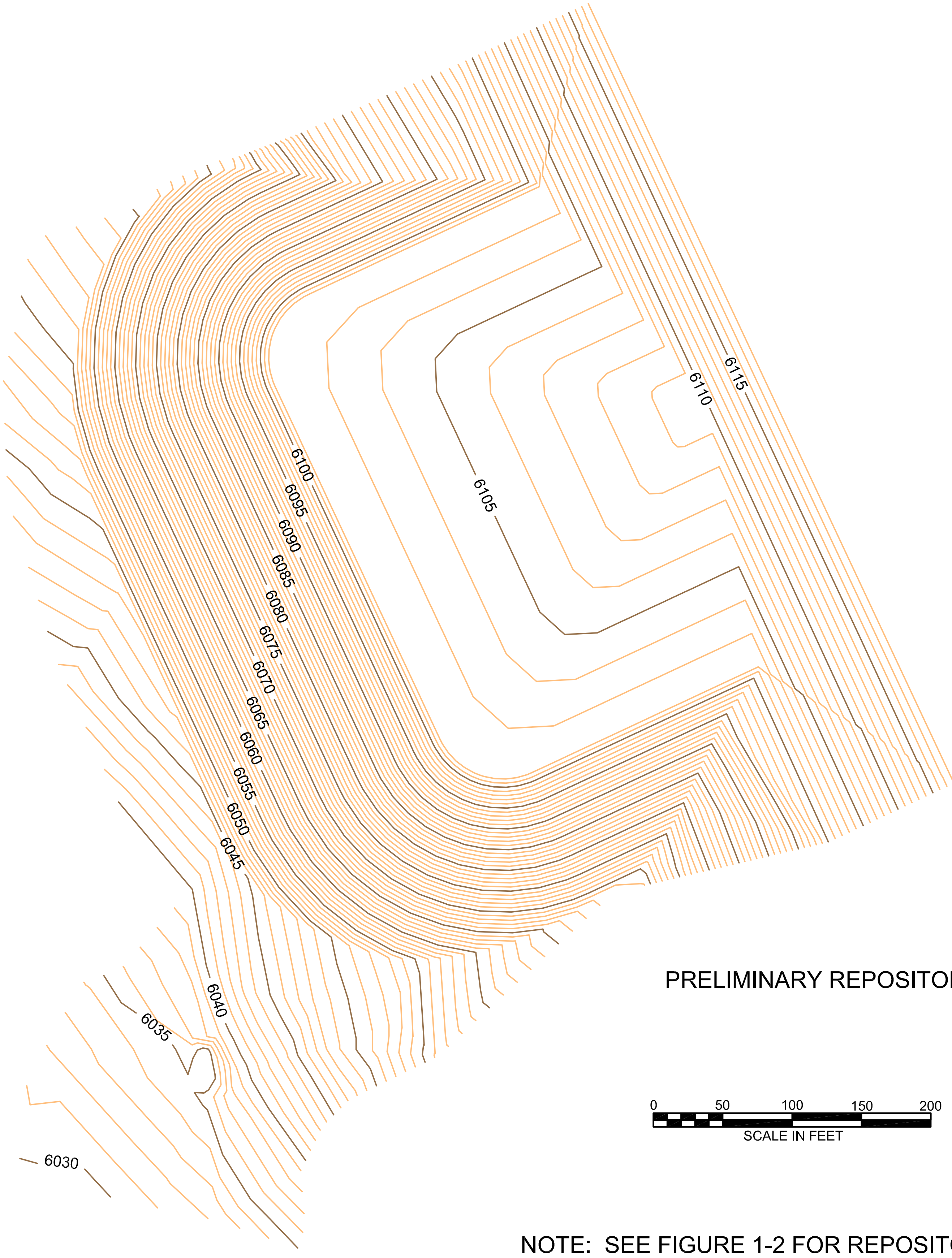
The location of the Bald Butte Millsite Repository is shown on Figure 1-2. Figure 3-9 shows the potential repository site area, preliminary repository design topography and waste depth contours. This area was selected largely because it is one of the only areas in the vicinity of the project that is relatively open and flat. The base of the repository would be constructed on a bench above Dog Creek, and keyed into the hillside to the northeast. The property is exclusively owned by Hartmut and Inga Baitis. The preliminary repository volume is estimated at up to 152,530 cubic yards. The preliminary design indicates that the repository would occupy 4.86 acres, have an average thickness of 19.4 feet, a maximum waste thickness of 46 feet, and a total repository height of 64 feet. This is enough storage volume to contain the mill tailings, Bald Butte waste rock piles (WR-1 through WR-4), the Devon/Sterling and Albion waste rock piles (WR1A through WR3A) and impacted native soils beneath the tailings piles (approximately 140,300 cubic yards).

The depth to bedrock in the potential repository area is not known, but is thought to be relatively shallow. Refusal was met in backhoe pits RP-2 and RP-3, which are located on a bench above the access road, because of boulders at depths of approximately 4 feet. The material encountered on the bench consists of silty sand with moderate to abundant gravel. The amount and size of rock increased with depth. Test pits RP-1 and RP-4 were excavated closer to the drainage bottom. Water was encountered in test pits RP-1 and RP-4 at depths of 5 feet and 7.8 feet below the ground surface, respectively. The material encountered in the lower portion of the repository was silty clay with moderate gravel (RP-1) and a stiff clay (RP-4). The clay in RP-4 extended to a depth greater than 7.8 feet.

Several other factors should be considered prior to using this potential repository area. First, the area has been previously logged and there are abundant tree stumps throughout the repository area that would need to be cleared, particularly if a bottom liner was to be installed. There is also abundant rock present on the surface. Second, there is a marshy area approximately 50 feet west of test pit RP-1, and a small stream channel that would run near the toe of the repository. Third, the clayey subgrade material in the lower portion of the repository would need to be characterized for potential settlement. Subsurface soil samples were collected from test pits RP-2, RP-3 and RP-4 for future analysis of geotechnical parameters.

3.8.2 Bald Butte/Great Divide Repository

The Bald Butte/Great Divide Repository is located approximately 1.5 miles from the Bald Butte Millsite on the Continental Divide. Three potential repository locations were evaluated on BLM land on the Continental Divide and only one was deemed suitable for use as a potential repository site. The three repository locations that were evaluated are shown on Figure 3-10. The southern-most site was deemed unsuitable because the topography was too steep and there was not enough area to provide sufficient storage volume. Shallow rock outcrops, insufficient cover soil thickness, and limited area made the northern-most repository site unsuitable. The central repository location was deemed as a suitable repository site. Test pits excavated in the repository area indicated that the soil was generally 3.5 to 5 feet thick. An exploration trench that had been previously excavated in the northeast portion of the repository area indicated a cover soil thickness of up to approximately 5 feet.



PRELIMINARY REPOSITORY DESIGN

0 50 100 150 200
SCALE IN FEET

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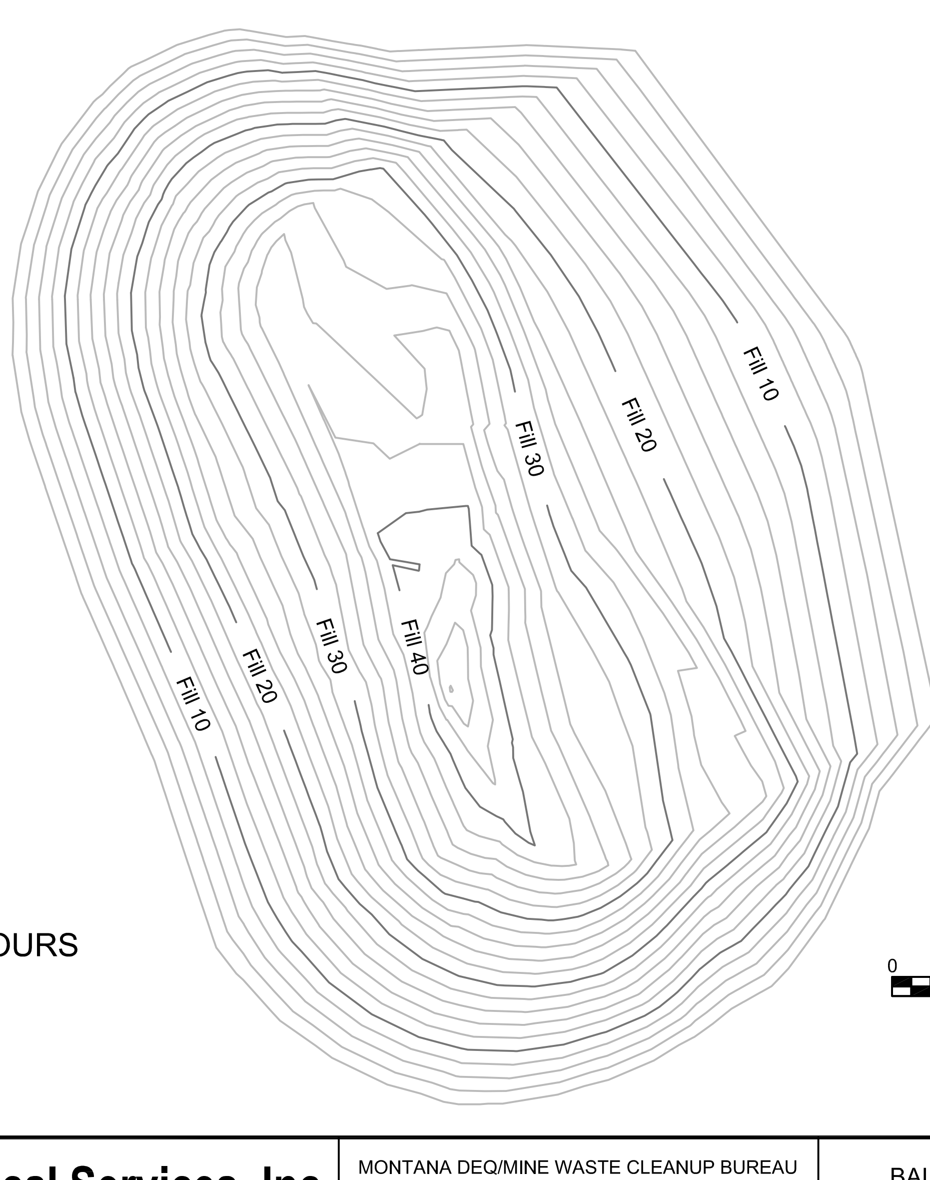
NOTE: SEE FIGURE 1-2 FOR REPOSITORY LOCATION



WASTE DEPTH CONTOURS

0 50 100 150 200
SCALE IN FEET

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Olympus Technical Services, Inc.	MONTANA DEQ/MINE WASTE CLEANUP BUREAU BALD BUTTE MILLSITE AND MINES LEWIS & CLARK COUNTY, MONTANA	BALD BUTTE MILLSITE AREA POTENTIAL REPOSITORY SITE	FIGURE 3-9

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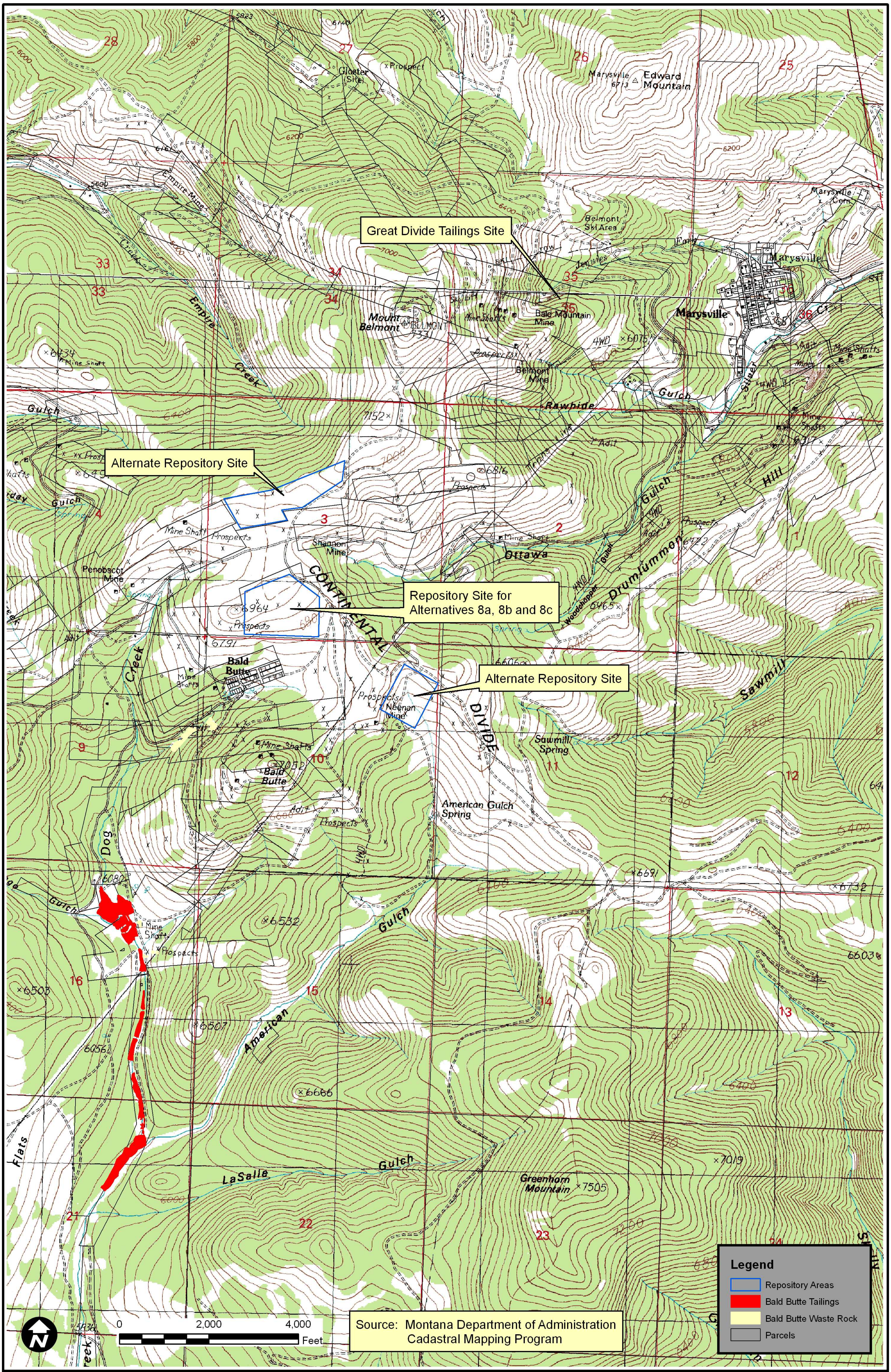


Olympus Technical Services, Inc.

MT DEQ/MINE WASTE CLEANUP BUREAU
BALD BUTTE MINE AND MILLSITE
LEWIS AND CLARK COUNTY, MONTANA

BALD BUTTE MILLSITE/GREAT DIVIDE TAILINGS POTENTIAL REPOSITORY SITE LOCATION

FIGURE 3-10

The Bald Butte Mine and Millsite wastes are estimated at approximately 140,300 cubic yards. In addition to mine wastes from the Bald Butte Mine and Mill Site, the proposed repository would receive approximately 40,000 cubic yards of mine wastes from the Great Divide Tailings Site, bringing the total volume to approximately 180,300 cubic yards.

Figure 3-11 shows the existing topography in the potential repository site area and the , preliminary repository design topography. The repository site was selected because it is located on BLM land, is strategically located between the Bald Butte and Great Divide sites, has favorable topography and drainage conditions, and has sufficient cover soil to accommodate both projects. The repository would be constructed along the top of an open grassy hillside and would be keyed into the existing hillside to the north. The preliminary repository volume is estimated at up to 234,000 cubic yards in the configuration shown on Figure 3-11. The preliminary design indicates that the repository would occupy 8.29 acres, have an average thickness of 13.5 feet, and a maximum waste thickness of 33 feet. This is enough storage volume to contain the mill tailings, Bald Butte waste rock piles (WR-1 through WR-4), the Devon/Sterling and Albion waste rock piles (WR1A through WR3A), impacted native soils beneath the tailings piles (approximately 140,300 cubic yards), and the wastes associated with the Great Divide Tailings Site (approximately 40,000 cubic yards).

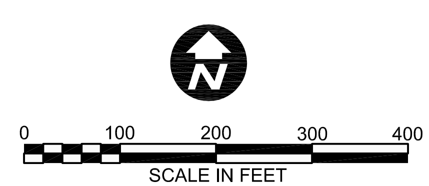
Test pits excavated during the site investigation indicate a thickness of 3.5 to 5.5 feet of available cover soil across the potential repository location. The material encountered consisted of loamy sand with moderate to abundant gravel. The amount and size of rock increased with depth. No ground water was encountered in test pits.

3.9 Potential Borrow Source Investigation

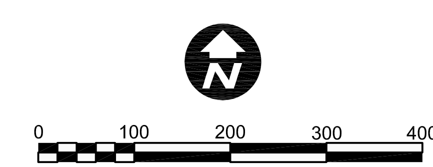
The available areas for potential cover soil borrow sources are limited in the Bald Butte Millsite and Devon/Sterling and Albion Mines project areas due to the steep, mountainous topography and the narrow drainage corridors. The two widest drainage bottom areas, TP-1/TP-2 and TP-6 were utilized for mill tailings disposal. In the case of the TP-6 area, nearly all of the drainage bottom is a wetlands environment. The wetlands were most likely formed as a result of the increased water holding capacity of the fine-grained tailings. The remainder of the Dog Creek drainage bottom in the project area is very narrow and bordered by steep topography.

In the tailings pile TP-1 and TP-2 areas, a number of earthen dams are present and appear to be native soil materials. The estimated volume of these earthen dams is 7,200 cubic yards. In other projects, these earthen dams have been used as cost effective sources for cover soils in reclamation. These structures were evaluated as potential sources of cover soil. Revegetation and particle size analytical results are summarized in Table 3-15. The revegetation and particle size results indicate that the earthen dams would meet the cover soil specifications (MDSL/AMRB, 1991). The range of organic matter contained in the earthen dams is 0.43 weight percent (wt. %) to 2.49 wt. %. Some organic amendment may be required if this material were used as cover soil. To further assess the earthen dam potential as cover soil, qualitative to semi-quantitative XRF screens of the samples were done. The data indicate that two elements of concern, As and Pb, can be elevated in the earthen dams. Arsenic concentrations range from 33 ppm to 222.6 ppm and Pb ranges from no detection to 1980 mg/Kg. The results indicate that some tailings have impacted the native soil earthen dams. Wind blown tailings dust is a likely source of these elevated contaminants in the surface areas of the dams.

EXISTING TOPOGRAPHY



PRELIMINARY REPOSITORY TOPOGRAPHY



NO.	REVISION DESCRIPTION	BY	DATE	DESIGN: JD APPROVED: KR SCALE: AS SHOWN	DRAWN: JS DATE: 8/2008 FILENAME: a1645BLMrepos.dwo	CHECKED: KR JOB NO: A1645	

MONTANA DEQ/ MINE WASTE CLEANUP BUREAU
BALD BUTTE MINE AND MILLSITE
LEWIS AND CLARK COUNTY, MONTANA

Olympus Technical Services, Inc.

PRELIMINARY DESIGN OF BALD BUTTE MILSITE/GREAT DIVIDE TAILINGS REPOSITORY

FIGURE 3-11

Table 3-15. Laboratory Revegetation and Miscellaneous Soils Particle Size Results

Sample ID	Physical Characteristics Sand (wt%)	Silt (wt%)	Clay (wt%)	Texture*	Chemical Characteristics pH (S.U.)	Conductivity, Saturated Paste (mmhos/cm)	Saturation (wt%)	Organic Matter (wt%)	Phosphorus mg/Kg	Nitrate + Nitrite as N mg/Kg	Potassium mg/Kg
25-179-BS1	30.0	47.5	22.5	L	5.8	0.30	39.8	2.49	18	9.3	210
25-179-BS2	42.5	40.0	17.5	L	6.0	0.37	39.9	2.00	11	7.9	190
25-179-BS3	55.0	30.0	15.0	L	5.5	0.19	20.7	0.43	14	<0.5	50
25-179-RP-1	25.0	57.5	17.5	SL	6.2	0.18	41.7	1.04	35	0.7	200

*C=Clay, S=Sand(y), Si=Silt(y), L=Loam(y)

Miscellaneous Soils Particle Size Results

Sample ID	Weight Percent Retained					Percent Finer by Weight					Percent Sand	Percent Silt	Percent Clay	Soil Texture
	Gravel	Sand			Silt/Clay	Gravel	Sand			Silt/Clay				
Sieve Size	3/4-in	#4	#10	#40	#200	3/4-in	#4	#10	#40	#200				
Opening (Inches)	0.75	0.187	0.0661	0.0106	0.0029	0.75	0.187	0.0661	0.0106	0.0029				
25-179-TP1-5	6.2	26.5	27.2	22.3	9.5	93.8	67.3	40.1	17.8	8.3	35.0	42.5	22.5	Loam
25-179-TP2-4	2.4	14.4	15	20.1	8.8	97.6	83.2	68.2	48.1	39.3	32.5	47.5	20.0	Loam
25-179-RP1	2.1	18.7	12.3	32.4	15.1	97.9	79.2	66.9	34.5	19.4	25.0	57.5	17.5	Silty Loam
25-179-BS1	2.5	14.2	16.7	54.2	8.4	97.5	83.3	66.6	12.4	4.0	30.0	47.5	22.5	Loam
25-179-BS2	1.0	16.7	18.3	49.4	10.2	99.0	82.3	64.0	14.6	4.4	42.5	40.0	17.5	Loam
25-179-BS3	2.1	24.8	10.4	36.0	21.3	97.9	73.1	62.7	26.7	5.4	55.0	30.0	15.0	Loam

LEGEND

25-179-BS1 is a grab composite sample of TP-2 earthen dam; lt. brown silty sand + predom gravel w/lesser rock ≤ 4" dia.
25-179-BS2 is a grab composite sample of TP-2 earthen dam; fine-grained silty sand soil + gravel + minor rock ≤ 4" dia.
25-179-BS3 is a grab composite sample of TP-1 earthen dam; lt. tan silty sand soil + gravel + lesser rock ≤ 6" dia.
25-179-RP-1 is a grab composite sample of RP2 and RP3 test pits in potential repository area
25-179-TP1-5 is a composite of TP1-2-2.7-4.1, TP1-4-2.0-3.0, TP1-13-8.0-9.4, TP1-22-4.6-5.7; native soil beneath tailings
25-179-TP2-4 is a composite of TP2-3-1.1-2.0, TP2-4-3.1-3.8 and TP2-6-1.5-2.4; native soil beneath tailings

Many of backhoe test pits and shovel/hand auger holes in tailings piles TP-1 and TP-2 intersected a native soil that resembles good topsoil-like material. Particle size analysis was run on one native soil composite sample in each tailings pile to evaluate the grain size distribution of this material beneath the tailings piles. The analytical results are summarized in Table 3-15. The gradations of this material would meet the cover soil specification (MDSL/AMRB, 1991). Laboratory analytical results (Table 3-4), however, indicate that the tailings are impacting the underlying native soils. The native soils are elevated in As (216 - 286 mg/Kg), Cd (8 - 12 mg/Kg), Hg (<1 - 1.2 mg/Kg), Pb (204 - 1900 mg/Kg), Zn (1340 - 2190 mg/Kg) and total cyanide (1.4 - 2.5 mg/Kg). These results indicate that the volume of native soil that might be available beneath the tailings piles in this area is very limited.

Additional cover soil source materials were evaluated in the Bald Butte Millsite Repository area. Test pits were excavated to evaluate the geology and assess the shallow groundwater conditions. A representative composite sample was collected from test pits RP2 and RP3 for revegetation and particle size gradation analysis. The results are summarized in Table 3-16. The data indicate that the native soil materials in the potential repository site would meet the cover soil specifications (MDSL/AMRB, 1991). As with the earthen dams, an organic amendment and fertilizer would likely be required for this material. The composite sample was also XRF screened and the data indicate that the analytical results for native soils in the potential repository area are consistent with background native soil concentrations. Based on the presence of shallow groundwater in a portion of the potential repository area (see Section 3.8), excavation in the repository area would be limited to a depth of approximately 2 feet. This would provide enough cover soil for the repository, but none for other purposes.

The flat area east of the TP-1 tailings pile lobe that extends toward the mill area did not have any field evidence of tailings. Field observations of native soil excavated from shovel pits in this area suggest that this material may be a potential cover soil borrow source. The volume, however, may be limited by the depth to shallow groundwater.

The preliminary evaluation of potential cover soil borrow sources in the patented claim blocks containing the project area indicates that cover soil sources appear to be limited. The majority of land surrounding the project area is controlled by the Helena National Forest or BLM. Any further investigation of potential cover soil borrow sources within a reasonable distance of the project area would require some agreement with these agencies.

Based on the site characterization, the Bald Butte/Great Divide Repository site, located at the top of the continental divide, has adequate cover soil for the project. The amount of cover soil available from within the preliminary repository footprint is estimated at 53,070 cubic yards. Of this total, approximately 27,000 cubic yards would be required to cover the repository with a 2-foot lift of cover soil. The BLM’s Great Divide Tailings site requires an estimated 12,000 cubic yards of cover soil. This would leave approximately 14,000 cubic yards of soil to cover the disturbed areas at the Bald Butte Mine and Millsite. Composite soil samples were collected from test pits excavated in the repository area and analyzed for revegetation parameters and particle size. The results of these analyses are summarized in Table 3-15. The data indicate that the native soil materials in the potential repository site would meet the cover soil specifications (MDSL/AMRB, 1991). The range of organic matter contained in the cover soil ranged from 1.75 percent by weight to 2.68 percent by weight. This is within the range of 1% to 20% specified for cover soil (MDSL/AMRB, 1991).

Table 3-16. Laboratory Cover Soil Results for Bald Butte Millsite/Great Divide Tailings Repository Site

Sample ID	pH Sat Pst. (s.u.)	Conductivity Sat Pst. mmhos/cm	Percent Saturation	Ca Sat Pst. meq/l	Mg Sat Pst. meq/l	Na Sat Pst. meq/l	SAR unitless	SO_4 Sat Pst. meq/l	Texture Sand %	Silt %	Clay %
A1645-1	7.2	0.51	42.6	3.50	0.56	0.52	0.36	0.366	42	42	16
A1645-2	7.4	0.44	45.7	3.20	0.35	0.57	0.43	0.349	38	44	18
A1645-3	7.3	0.51	46.2	3.49	0.44	0.65	0.46	0.448	59	24	17
A1645-4	6.6	0.66	46.8	4.66	1.25	0.48	0.28	0.293	40	42	18

Sample ID	Texture	K NH4OAc meq/100 g	CEC meq/100 g	Organic Matter %	Lime %	P-Olsen mg/kg	NO_3 mg/kg	Ca-Ext meq/100 g	Mg-Ext meq/100 g	K-Ext meq/100 g	Na-Ext meq/100 g	Base Sat. %
A1645-1	L	98	26.8	1.75	12.2	2.1	6	25.9	0.98	0.25	0.42	101
A1645-2	L	110	24.8	2.11	6.7	1.3	8	26.2	0.65	0.28	0.46	113
A1645-3	SL	124	25.6	2.14	11.6	1.6	10	27.7	0.82	0.32	0.47	112
A1645-4	L	154	27.3	2.68	3.1	1.7	6	27.0	1.9	0.39	0.42	95

Notes:
Sat. Pst. = Saturated Paste
L = Loam
SL = Sandy Loam
Ext. = Extractable

8.9 Alternative 8A: Off-Site Disposal of Tailings and Waste Rock in a Constructed RCRA-Style Repository Located On the continental Divide

Under Alternative 8a, a mine/mill waste repository would be constructed approximately 1.5 miles northeast of the Bald Butte Millsite near the top of the Continental Divide on public land administered by the Bureau of Land Management. The repository would receive mine/mill waste from the Bald Butte Mine and Millsite and the Great Divide Tailings Site located near Marysville, Montana, which is under the jurisdiction of the BLM. The repository would be constructed under an agreement between the Montana Department of Environmental Quality and the BLM. The repository location is shown on Figure 3-10.

The reclamation strategy for Alternative 8a involves removing all mill tailings and waste rock sources and disposing these wastes in a constructed repository which complies with RCRA Subtitle C regulations for hazardous waste landfill closures (Figure 7-1). The only exception to the RCRA Subtitle C regulations would be the use of a geosynthetic clay liner (GCL) in place of a compacted clay liner. This is based on the site characterization results, which did not reveal the presence of a clay borrow source in the vicinity of the site. The repository would consist of a composite, double-lined leachate collection and removal system underlying the waste in conjunction with a composite, multi-layered, lined cap overlying the waste. Assuming that the tailings, waste rock and impacted soil volume was deposited in an area of approximately 8.29 acres, the total height of the repository would be approximately 85 feet, with a maximum waste thickness of approximately 33 feet, in order to achieve a 3:1 side slope design in the final cap.

The flowing adit at waste rock pile WR1A (sample GW1) exceeds Federal maximum contaminant levels (MCLs) and Montana human health standards (HHS) for Cd (18 ug/L) and Mn (310 ug/L), and Montana HHS for Zn (3,550 ug/l). In addition, Cd, Cu and Zn exceed acute and chronic aquatic life standards (ALS) and Pb exceeds chronic ALS in the mine adit discharge water. The underground workings are the most likely source of metals in the adit discharge. Sealing the adits to stop the discharge is not considered a reliable control measure because the flow will likely build up in the extensive underground workings and emerge uncontrolled from another location. Based on the above discussion, there is no effective means to control the discharge without the use of high-cost, high-maintenance treatment systems. Long-term treatment of the adit discharge water is considered cost prohibitive and infeasible.

Under Alternative 8a, the adit discharge water would be collected near the adit opening and conveyed to an infiltration gallery in the valley floor where it will infiltrate into the alluvium. The purpose of the infiltration gallery is to eliminate the potential ingestion of the adit discharge water.

The HELP model was used to simulate the RCRA Subtitle C repository scenario. Based on representative soil properties for the 1.5-foot cover soil, gravel drainage layer, 20-mil flexible membrane liner, geosynthetic clay liner (substituted for the compacted clay liner), an average of 13.5 feet of mine/mill waste, a gravel primary leachate collection/removal layer, 30-mil flexible membrane liner, a gravel secondary leachate collection/removal layer, a 30-mil flexible membrane liner and a geosynthetic clay liner (substituted for the compacted clay liner), the predicted infiltration of water through the repository base liner system is an average of 0.00000 inches per year over a 30-year period. An average of 14.498 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.938 percent of the average annual precipitation of 15.94 inches. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or 1.001 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil.

8.9.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings and waste rock source areas. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06. Routing of the adit discharge water to an infiltration gallery would eliminate ingestion of the water, which exceeds both human health and aquatic life standards.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-24.

8.9.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-25 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that

Table 8-24. Risk Reduction Achievement Matrix for Alternative 8a

Exposure Pathway	Risk Level	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
		Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-25. Water Quality ARARs Attainment for Alternative 8a

	Arsenic		Cadmium		Copper		Lead		Manganese		Zinc	
	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal	Cleanup Goal	Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

Unk - Unknown. Cleanup goal is less than the detection limit.

elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Cadmium, manganese, and zinc exceed Federal MCLs or Montana HHS criteria and cadmium, copper and zinc exceed acute and chronic and lead exceeds chronic aquatic life standards in the discharge from the adit at waste rock pile WR1A. Under this alternative, it is proposed that the adit discharge be collected and discharged to a subsurface infiltration gallery. The adit discharge currently flows into the unnamed tributary to Dog Creek and flows over waste rock pile WR1A. Subsurface disposal of the adit discharge will effectively eliminate the direct exposure pathway under a recreational risk scenario (i.e., hikers, etc. drinking directly from the adit). However, this scenario is not necessarily protective of ground water resources. Ground water was not characterized during the site characterization.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, the U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.9.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be encapsulated in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.9.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings and waste rock from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be encapsulated in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.9.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in two or three construction seasons. Impacts associated with construction activities would generally be less than 120 days per year and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.9.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.9.7 Costs

The total present-worth cost for this alternative has been estimated at $6,968,034 which represents the removal of the tailings, waste rock and impacted soil to a constructed RCRA-style repository with leachate collection system. Table 8-26 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Table 8-26. Preliminary Cost Estimate for Alternative 7a: On-Site Disposal of Tailings and Waste Rock in a Constructed RCRA Repository

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	406,476	$406,476	8%
Logistics					
Access Road Improvements	26,800	LF	1.00	$26,800	
Site Clearing/Preparation	31.20	Ac	2,000	$62,400	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Unnamed Tributary Stream Diversion	600	LF	25.00	$15,000	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	15,000	$15,000	
Repository Construction					
Cover Soil Removal and Stockpiling	53,100	CY	2.00	$106,200	
Repository Base Grading	8.27	Ac	2,000	$16,540	
Install Geotextile Cushion	40,040	SY	3.00	$120,120	
Geosynthetic Clay Liner	40,040	SY	4.50	$180,180	
Install 30 mil Flexible Membrane Liner	40,040	SY	6.00	$240,240	
Gravel Drainage Layer	13,350	CY	20.00	$267,000	
Install 30 mil Flexible Membrane Liner	40,040	SY	6.00	$240,240	
Gravel Drainage Layer	13,350	CY	20.00	$267,000	
Geotextile Filter Fabric	40,040	SY	3.00	$120,120	
Leachate Collection System	1	LS	20,000	$20,000	
Waste Load, Haul & Dump					
Tailings	70,650	CY	10.00	$706,500	
Dog Creek Floodplain Tailings	7,510	CY	12.00	$90,120	
Impacted Soil	33,830	CY	10.00	$338,300	
Bald Butte Waste Rock	2,874	CY	10.00	$28,740	
Devon/Sterling and Albion Waste Rock	32,940	CY	9.00	$296,460	
Waste Grading and Compaction	147,804	CY	2.00	$295,608	
Repository Cap Construction					
Install Geotextile Cushion	40,140	SY	3.00	$120,420	
Geosynthetic Clay Liner	40,140	SY	4.50	$180,630	
Install 20 mil Flexible Membrane Liner	40,140	SY	5.00	$200,700	
Geocomposite Drainage Layer	40,140	SY	4.50	$180,630	
Cover Soil	26,400	CY	2.00	$52,800	
Stream Channel Reconstruction	7,100	LF	80.00	$568,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Adit Discharge Infiltration Gallery	1	LS	10,000	$10,000	
Grade Native Soil Dams	7,200	CY	2	$14,400	
Revegetation					
Seed/Fertilize	31.20	Ac	1,000	$31,200	
Mulch	31.20	Ac	1,000	$31,200	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,650	LF	6.00	$15,900	
Subtotal				$5,487,424	
Construction Oversight	15%			$823,114	
Subtotal Capital Costs				$6,310,538	
Contingency	10%			$631,054	
TOTAL CAPITAL COSTS				$6,941,591	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$6,941,591	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$6,968,034	

Conceptual Design and Assumptions

The repository would be constructed approximately 1.5 miles northeast of the Bald Butte millsite on public land administered by the Bureau of Land Management. The repository would be used to contain wastes from both the Bald Butte Mine and Millsite and the Great Divide Tailings Site. The repository site was selected because it is located on BLM land, is strategically located between the two sites, has favorable topography and drainage conditions, and has sufficient cover soil to accommodate both projects. Two alternative sites on nearby BLM land were also considered, but they did not meet the project requirements because of shallow bedrock, lack of cover soil, and/or unfavorable size or topography. The site selected for the repository is an open hill side that slopes gently to the southeast. The proposed location is largely devoid of trees and a test pit investigation confirmed that the location contains an adequate volume of cover soil. Because the proposed repository site is located along the top of the Continental Divide, there is a possibility that shallow outcrops may be present within the repository area. Shallow rock outcrops could pose a problem for the installation of the bottom liner. Any exposed rock could potentially damage liner materials when the liner is loaded with waste material. In addition, there may be some trees, stumps, and several abandoned power poles that would require removal prior to the installation of the base GCL liner. The conceptual design of the repository is shown on Figure 3-11. The repository is designed to accommodate a waste volume of approximately 230,000 cubic yards, which includes 150,000 cubic yards of waste and impacted soil from the Bald Butte mine and millsite, 40,000 cubic yards of mine/mill waste from the Great Divide Tailings Site, and a 20 percent volume contingency of approximately 40,000 cubic yards.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders, and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings piles would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Approximately 12,000 cubic yards of cover soil would be designated for use at the Great Divide Tailings Site. Native soil from the TP-1 and TP-2 dams would be graded onto the excavated source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 8a are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;
- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facilitate tailings removal and site reclamation;
- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;
- placement of the repository base liner and leachate collection system;
- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;
- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;
- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4 and WR1A through WR3A;
- installation of the cap liners and geocomposite drainage layer;
- placement and grading of stockpiled cover soil on the repository;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;
- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6;
- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;
- reconstruction of the unnamed tributary of Dog Creek through a portion waste rock pile WR1A;
- diversion of adit discharge water to a subsurface infiltration gallery to eliminate exposure by direct contact;
- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;

- mulching of the seeded areas;
- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and
- construction of a woven-wire fence around the repository.

8.10Alternative 8B: On-Site Disposal of Tailings and Waste Rock in a Constructed Modified RCRA-Style Repository Located On the continental Divide

Under Alternative 8b, a mine/mill waste repository would be constructed approximately 1.5 miles northeast of the Bald Butte Millsite near the top of the Continental Divide on public land administered by the Bureau of Land Management. The repository would receive mine/mill waste from the Bald Butte Mine and Millsite and the Great Divide Tailings Site located near Marysville, Montana, which is under the jurisdiction of the BLM. The repository would be constructed under an agreement between the Montana Department of Environmental Quality and the BLM. The repository location is shown on Figure 3-10.

The reclamation strategy for Alternative 8b involves removing all mill tailings and waste rock sources and disposing these wastes in a constructed modified RCRA-style repository which includes a single GCL base liner (without a leachate collection and removal system) and a multi-layered cap (Figure 7-2). The repository would consist of a geosynthetic clay liner underlying the waste in conjunction with a composite, multi-layered, lined cap overlying the waste. Assuming that the mine/mill waste volume was deposited in an area of approximately 8.29 acres, the total height of the repository would be approximately 85 feet, with a maximum waste thickness of approximately 33 feet, in order to achieve a 3:1 side slope design in the final cap.

The flowing adit at waste rock pile WR1A (sample GW1) exceeds Federal MCLs and Montana HHS for Cd (18 ug/L) and Mn (310 ug/L), and Montana HHS for Zn (3,550 ug/l). In addition, Cd, Cu and Zn exceed acute and chronic ALS and Pb exceeds chronic ALS in the mine adit discharge water. The underground workings are the most likely source of metals in the adit discharge. Sealing the adits to stop the discharge is not considered a reliable control measure because the flow will likely build up in the extensive underground workings and emerge uncontrolled from another location. Based on the above discussion, there is no effective means to control the discharge without the use of high-cost, high-maintenance treatment systems. Long-term treatment of the adit discharge water is considered cost prohibitive and infeasible.

Under Alternative 8b, the adit discharge water would be collected near the adit opening and conveyed to an infiltration gallery in the valley floor where it will infiltrate into the alluvium. The purpose of the infiltration gallery is to eliminate the potential ingestion of the adit discharge water.

The HELP model was used to simulate the modified RCRA-style repository scenario. Based on representative soil properties for the 1.5-foot cover soil, geocomposite drainage layer, geosynthetic clay liner, an average of 13.5 feet of mine/mill waste, a base flexible membrane liner, and a base geosynthetic clay liner, the predicted infiltration of water through the repository base liner system is an average of 0.00000 inches per year over a 30-year period. An average of 14.498 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.931 percent of the average annual precipitation of 15.94 inches. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or 1.001 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil.

8.10.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings and waste rock source areas. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06. Routing of the adit discharge water to an infiltration gallery would eliminate ingestion of the water, which exceeds both human health and aquatic life standards.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-27.

8.10.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-28 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that elevated levels of these contaminants in surface water are attributed to the presence of

Table 8-27. Risk Reduction Achievement Matrix for Alternative 8b

Exposure Pathway	Risk Level	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-28. Water Quality ARARs Attainment for Alternative 8b

	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

Unk - Unknown. Cleanup goal is less than the detection limit.

contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Cadmium, manganese and zinc exceed Federal MCLs or Montana HHS criteria and cadmium, copper and zinc exceed acute and chronic and lead exceeds chronic aquatic life standards in the discharge from the adit at waste rock pile WR1A. Under this alternative, it is proposed that the adit discharge be collected and discharged to a subsurface infiltration gallery. The adit discharge currently flows into the unnamed tributary to Dog Creek and flows over waste rock pile WR1A. Subsurface disposal of the adit discharge will effectively eliminate the direct exposure pathway under a recreational risk scenario (i.e., hikers, etc. drinking directly from the adit). However, this scenario is not necessarily protective of ground water resources. Ground water was not characterized during the site characterization.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, the U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.10.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be encapsulated in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.10.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings and waste rock from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be encapsulated in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.10.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in two or three construction seasons. Impacts associated with construction activities would generally be less than 120 days per year and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.10.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.10.7 Costs

The total present-worth cost for this alternative has been estimated at $5,115,423 which represents the removal of the tailings, waste rock and impacted soil to a constructed modified RCRA-style repository. Table 8-29 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Table 8-29. Preliminary Cost Estimate for Alternative 8b: On-Site Disposal of Tailings and Waste Rock in a Constructed Modified RCRA Repository

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	298,052	$298,052	8%
Logistics					
Access Road Improvements	26,800	LF	1.00	$26,800	
Site Clearing/Preparation	31.20	Ac	2,000	$62,400	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Unnamed Tributary Stream Diversion	600	LF	25.00	$15,000	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	15,000	$15,000	
Repository Construction					
Cover Soil Removal and Stockpiling	53,100	CY	2.00	$106,200	
Repository Base Grading	8.27	Ac	2,000	$16,540	
Install Geotextile Cushion	40,040	SY	3.00	$120,120	
Geosynthetic Clay Liner	40,040	SY	4.50	$180,180	
Waste Load, Haul & Dump					
Tailings	70,650	CY	10.00	$706,500	
Dog Creek Floodplain Tailings	7,510	CY	12.00	$90,120	
Impacted Soil	33,830	CY	10.00	$338,300	
Bald Butte Waste Rock	2,874	CY	10.00	$28,740	
Devon/Sterling and Albion Waste Rock	32,940	CY	9.00	$296,460	
Waste Grading and Compaction	147,804	CY	2.00	$295,608	
Repository Cap Construction					
Install Geotextile Cushion	40,140	SY	3.00	$120,420	
Geosynthetic Clay Liner	40,140	SY	4.50	$180,630	
Geocomposite Drainage Layer	40,140	SY	4.50	$180,630	
Cover Soil	26,400	CY	2.00	$52,800	
Stream Channel Reconstruction	7,100	LF	80.00	$568,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Adit Discharge Infiltration Gallery	1	LS	10,000	$10,000	
Grade Native Soil Dams	7,200	CY	2	$14,400	
Revegetation					
Seed/Fertilize	31.20	Ac	1,000	$31,200	
Mulch	31.20	Ac	1,000	$31,200	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,650	LF	6.00	$15,900	
Subtotal				$4,023,700	
Construction Oversight	15%			$603,555	
Subtotal Capital Costs				$4,627,255	
Contingency	10%			$462,726	
TOTAL CAPITAL COSTS				$5,089,981	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$5,089,981	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$5,116,423	

Conceptual Design and Assumptions

The repository would be constructed approximately 1.5 miles northeast of the Bald Butte millsite on public land administered by the Bureau of Land Management. The repository would be used to contain wastes from both the Bald Butte Mine and Millsite and the Great Divide Tailings Site. The repository site was selected because it is located on BLM land, is strategically located between the two sites, has favorable topography and drainage conditions, and has sufficient cover soil to accommodate both projects. Two alternative sites on nearby BLM land were also considered, but they did not meet the project requirements because of shallow bedrock, lack of cover soil, and/or unfavorable size or topography. The site selected for the repository is an open hill side that slopes gently to the southeast. The proposed location is largely devoid of trees and a test pit investigation confirmed that the location contains an adequate volume of cover soil. Because the proposed repository site is located along the top of the Continental Divide, there is a possibility that shallow outcrops may be present within the repository area. Shallow rock outcrops could pose a problem for the installation of the bottom liner. Any exposed rock could potentially damage liner materials when the liner is loaded with waste material. In addition, there may be some trees, stumps, and several abandoned power poles that would require removal prior to the installation of the base GCL liner. The preliminary design of the repository is shown on Figure 3-11. The repository is designed to accommodate a waste volume of approximately 230,000 cubic yards, which includes 150,000 cubic yards of waste and impacted soil from the Bald Butte mine and millsite, 40,000 cubic yards of mine/mill waste from the Great Divide Tailings Site, and a 20 percent volume contingency of 40,000 cubic yards.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings piles would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Approximately 12,000 cubic yards of cover soil would be designated for use at the Great Divide Tailings Site. Native soil from the TP-1 and TP-2 dams would be graded onto the excavated source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 8b are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;
- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facilitate tailings removal and site reclamation;
- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;
- placement of the repository base GCL liner;
- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;
- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;
- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4 and WR1A through WR3A;
- installation of the cap GCL liner and geocomposite drainage layer;
- placement and grading of stockpiled cover soil on the repository;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;
- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6;
- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;
- reconstruction of the unnamed tributary of Dog Creek through a portion waste rock pile WR1A;
- diversion of adit discharge water to a subsurface infiltration gallery to eliminate exposure by direct contact;
- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;

- mulching of the seeded areas;
- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and
- construction of a woven-wire fence around the repository.

8.11 Alternative 8C: On-Site Disposal of Tailings and Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap Located On the continental Divide

Under Alternative 8c, a mine/mill waste repository would be constructed approximately 1.5 miles northeast of the Bald Butte Millsite near the top of the Continental Divide on public land administered by the Bureau of Land Management. The repository would receive mine/mill waste from the Bald Butte Mine and Millsite and the Great Divide Tailings Site located near Marysville, Montana, which is under the jurisdiction of the BLM. The repository would be constructed under an agreement between the Montana Department of Environmental Quality and the BLM. The repository location is shown on Figure 3-10.

The reclamation strategy for Alternative 8c involves removing all mill tailings, waste rock and impacted soil and disposing these wastes in a constructed unlined repository with a multi-layered cap (Figure 7-3). The repository would consist of a composite, multi-layered, lined cap overlying the waste. Assuming that the waste sources are deposited in an area of approximately 8.29 acres, the total height of the repository would be approximately 85 feet, with a maximum waste thickness of approximately 33 feet, in order to achieve a 3:1 side slope design in the final cap.

The flowing adit at waste rock pile WR1A (sample GW1) exceeds Federal MCLs and Montana HHS for Cd (18 ug/L) and Mn (310 ug/L), and Montana HHS for Zn (3,550 ug/l). In addition, Cd, Cu and Zn exceed acute and chronic ALS and Pb exceeds chronic ALS in the mine adit discharge water. The underground workings are the most likely source of metals in the adit discharge. Sealing the adits to stop the discharge is not considered a reliable control measure because the flow will likely build up in the extensive underground workings and emerge uncontrolled from another location. Based on the above discussion, there is no effective means to control the discharge without the use of high-cost, high-maintenance treatment systems. Long-term treatment of the adit discharge water is considered cost prohibitive and infeasible.

Under Alternative 8c, the adit discharge water would be collected near the adit opening and conveyed to an infiltration gallery in the valley floor where it will infiltrate into the alluvium. The purpose of the infiltration gallery is to eliminate the potential ingestion of the adit discharge water.

The HELP model was used to simulate the unlined repository with a multi-layered cap scenario. Based on representative soil properties for the 1.5-foot cover soil, geocomposite drainage layer, geosynthetic clay liner, and an average of 13.5 feet of mine/mill waste, the predicted infiltration of water through the tailings is an average of 0.00063 inches per year over a 30-year period. This is equivalent to 0.004 percent of the average annual precipitation of 15.94 inches. An average of 14.498 inches of water per year is predicted to be lost through evapotranspiration, which is equivalent to 90.931 percent of the average annual precipitation. Surface water runoff accounts for a loss of 1.196 inches per year or 7.500 percent of precipitation. Lateral drainage from the geocomposite drainage layer accounts for a loss of 0.160 inches of water per year or

1.005 percent of precipitation. The remaining 0.561 percent of precipitation is accounted for by changes in water storage in the cover soil and tailings layers. The 0.00063 inches per year over the 8.29 acre repository area that is predicted to percolate from the bottom of the repository is equal to a discharge rate of 0.386 gallons per day over a 30 year period.

8.11.1 Overall Protection of Human Health and the Environment

This alternative provides control of direct exposure to the contaminated materials and reduction in risk to human health and the environment. It prevents further erosion and migration of contaminants from tailings source areas. Existing sediment in Dog Creek is not removed in this alternative, however, existing stream sediments should be diluted by mixing with natural sediment or through bedload dispersion downstream to achieve risk-based cleanup goals based on existing background levels.

Placing the wastes into a repository would prevent exposure by direct contact. Exposure to arsenic and lead via ingestion of water/fish is expected to be reduced to below risk-based cleanup goals since further erosion of contaminated sediments into Dog Creek would be prevented. Manganese exposure via the fish ingestion pathway would be reduced to levels consistent with background water quality, but would not achieve risk-based cleanup goals. Cleanup below background concentrations is not considered achievable. Carcinogenic risk from ingestion of arsenic via ingestion of water/fish would not be reduced to 1E-06. Routing of the adit discharge water to an infiltration gallery would eliminate ingestion of the water, which exceeds both human health and aquatic life standards.

Soil ingestion/dust inhalation of arsenic, lead and manganese would be reduced to below risk-based cleanup goals. Carcinogenic risk from soil ingestion/dust inhalation of arsenic would not be reduced to 1E-06.

Protection of the environment would generally be achieved under this alternative. Prevention of ecological exposures via exposure to water, sediment, and soil sources would be achieved to the extent practicable: deer exposure to lead via ingestion of tailings salts; plant phytotoxicity to arsenic, cadmium, copper, lead, manganese and zinc; acute exposure of aquatic life to arsenic, cadmium, copper, lead and zinc via surface water; and aquatic life exposure to cadmium and zinc via sediment would be reduced to risk-based cleanup levels. Since the waste sources would be removed from the vicinity of Dog Creek, arsenic, lead and zinc concentrations in the stream sediment would be reduced to levels consistent with background as existing sediments are either diluted by mixing with natural sediment or through bedload dispersion downstream, however, these concentrations may not be reduced below risk-based cleanup goals. A risk reduction achievement matrix for the various pathways and contaminants, identified in the baseline human health risk assessment and the ecological risk assessment, is shown in Table 8-30.

8.11.2 Compliance with ARARs

With the exception of lead and manganese, contaminant-specific ARARs are expected to be met when implementing this alternative. Table 8-31 shows that drinking water MCLs and/or HHS for arsenic, cadmium, copper, lead and zinc and ambient water quality criteria for arsenic and zinc are achieved in Dog Creek under this alternative. This is based on the assumption that

Table 8-30. Risk Reduction Achievement Matrix for Alternative 8c

Exposure Pathway	Risk Level	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Human Risk:													
Water Ingestion/Fish Ingestion Pathway (ug/l)	HQ=1	36.7	Yes					165	Yes	33.7	No		
	Carc. 1E-06	0.158	No										
	Carc. 1E-05	1.58	No										
	Carc. 1E-04	15.8	Yes										
Soil Ingestion/Dust Inhalation Pathway (mg/Kg)	HQ=1	323	Yes					2200	Yes	1330	Yes		
	Carc. 1E-06	1.39	No										
	Carc. 1E-05	13.9	No										
	Carc. 1E-04	139	Yes										
Ecological Risk Scenario:	EQ=1												
Deer - Tailings Salt Ingestion (mg/Kg)	LOAEL	NA		NA		NA		314	Yes	NA		NA	
Plant Phytotoxicity - Soil (mg/Kg)	Max Phytotox.	50	Yes	8	Yes	125	Yes	400	Yes	3000	Yes	400	Yes
Aquatic Life - Water (ug/l)	AALS	340	Yes	2.1	Yes	14	Yes	81.6	Yes	NA		120	Yes
Aquatic Life - Sediment (mg/Kg)	PSQC	85	No	9	Yes	390	Yes	110	No	NA		270	No

Notes: NA - Not Applicable

LOAEL - Lower observed adverse effect level

AALS - Freshwater Acute Aquatic Life Standards (DEQ, 2002). Hardness = 100 mg/l $CaCO_3$ for hardness dependent elements.

PSQC - Proposed Sediment Quality Criteria

Table 8-31. Water Quality ARARs Attainment for Alternative 8c

	Arsenic Cleanup Goal	Arsenic Achieve Goal	Cadmium Cleanup Goal	Cadmium Achieve Goal	Copper Cleanup Goal	Copper Achieve Goal	Lead Cleanup Goal	Lead Achieve Goal	Manganese Cleanup Goal	Manganese Achieve Goal	Zinc Cleanup Goal	Zinc Achieve Goal
Drinking Water MCL/HHS	18	Yes	5	Yes	1300	Yes	15	Yes	50	No	2000	Yes
Aquatic Life CALS	150	Yes	0.27	Unk	9.3	Unk	3.2	No	NA		119.8	Yes

HHS - Human Health Standards for Surface Water (DEQ, 2002)

MCL - Maximum Contaminant Level Drinking Water Regulations and Health Advisories, (EPA, 1993)

CALS - Freshwater Chronic Aquatic Life Standards (DEQ, 2002)

Water concentrations in ug/L.

CALS based on water hardness of 100 mg/L.

Unk - Unknown. Cleanup goal is less than the detection limit.

elevated levels of these contaminants in surface water are attributed to the presence of contaminated sediments in Dog Creek and that sediments will eventually be sufficiently diluted such that they do not cause significant metals loading to Dog Creek. Implementation of this alternative will prevent further erosion of tailings into Dog Creek. Drinking water MCLs and/or HHS for manganese and ambient water quality criteria for lead are not achieved under this alternative. Background water quality exceeds MCLs and/or HHS for manganese and exceeds CALS for lead. However, cleanup below background concentrations is not considered achievable. Ambient water quality standards for cadmium and copper may be achieved; however, this is unknown because the laboratory detection limit for these elements was greater than the water quality standard.

Cadmium, manganese and zinc exceed Federal MCLs or Montana HHS criteria and cadmium, copper and zinc exceed acute and chronic and lead exceeds chronic aquatic life standards in the discharge from the adit at waste rock pile WR1A. Under this alternative, it is proposed that the adit discharge be collected and discharged to a subsurface infiltration gallery. The adit discharge currently flows into the unnamed tributary to Dog Creek and flows over waste rock pile WR1A. Subsurface disposal of the adit discharge will effectively eliminate the direct exposure pathway under a recreational risk scenario (i.e., hikers, etc. drinking directly from the adit). However, this scenario is not necessarily protective of ground water resources. Ground water was not characterized during the site characterization.

Implementation of this alternative is also expected to satisfy air quality regulations because the repository cap and vegetation cover would stabilize the contaminant sources and inhibit fugitive emissions. The tailings have the highest potential for fugitive emissions based on grain size.

Location-specific ARARs are expected to be met in the implementation of this alternative. Contacts with the appropriate agencies and acquisition of required permits related to streambeds, floodplains, and archaeological/paleontological resources would be completed.

Action-specific ARARs are expected to be met including the hydrological regulations contained in the Strip and Underground Mine Reclamation Act. The tailings and waste rock materials of concern are derived from the beneficiation and extraction of ores and are therefore exempt from federal regulation under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6921 (b) (3) (A)(iii)(1994) as a hazardous waste. Mine and mill wastes are also excluded under the Montana Solid Waste Management Act (75-10-214 (1)(b) MCA. Any temporary stream diversions for construction activities will require coordination with the Montana Department of Fish, Wildlife, and Parks, the U.S. Army Corps of Engineers, the Montana Department of Natural Resources and Conservation, and the Lewis & Clark County Conservation District. Revegetation requirements contained in the Surface Mining and Control Reclamation Act would be met. State of Montana air quality regulations related to dust suppression and control during construction activities will be met using water sprays where applicable, i.e. excavation areas in the tailings and waste rock and haul roads with heavy vehicular traffic.

Occupational Safety and Health Administration (OSHA) requirements would be met by requiring appropriate safety training for all on-site workers during the construction phase. Site activities would be conducted under the guidance of a Health and Safety Plan for the site as per OSHA 29 CFR 1910.120. Site personnel will have completed 40-hour hazardous waste operations and emergency response training and would be current on the 8-hour annual refresher training as required by OSHA.

8.11.3 Long-Term Effectiveness and Permanence

This alternative would reduce contaminant mobility at the site by removing the highest risk, solid media contaminant sources and disposing of these wastes in an engineered repository. The tailings, waste rock and impacted soil would be covered in an engineered repository that would effectively isolate this waste and reduce contaminant mobility. Periodic inspections and maintenance would ensure the long-term stability of the repository.

8.11.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of contaminant mobility is the primary objective of this alternative. The volume or toxicity of the contaminants in the tailings and waste rock would not be physically nor chemically reduced. The excavation of the tailings from the drainage area would reduce the contaminant mobility by moving the waste to a secure location. The primary waste sources of concern (tailings and waste rock piles) would be placed in an engineered structure and physical location which is protected from erosion and water infiltration problems.

8.11.5 Short-Term Effectiveness

It is anticipated that construction activities related to the implementation of this alternative would be completed in two or three construction seasons. Impacts associated with construction activities would generally be less than 120 days per year and should not significantly impact human health nor the environment. On-site workers would be protected by following a site specific Health and Safety Plan, employing appropriate personal protective equipment and by following proper operating and safety procedures. However, short term air quality impacts to the immediate environment may occur due to the relatively large volume of waste excavation and hauling. Control of fugitive dust may require the use of water sprays. Short-term impacts to the surrounding community are expected to be minimal due to the location of the project site. The only foreseen short-term impact to the surrounding community would involve increased vehicle traffic, with associated safety hazards and dust generation, on roads in the vicinity of the waste sources and the repository.

8.11.6 Implementability

This alternative is both technically and administratively feasible. Waste removal, repository construction, and establishing vegetation are readily implementable using conventional construction techniques. Key project components, such as the availability of equipment, materials, and construction expertise, are present and would aid in the timely implementation and successful execution of the proposed project.

8.11.7 Costs

The total present-worth cost for this alternative has been estimated at $4,706,153 which represents the removal of the tailings, waste rock and impacted soil to a constructed unlined repository with a multi-layered cap. Table 8-32 presents the cost details associated with implementing this alternative. The total cost includes the present-worth value of 30 years of annual maintenance and monitoring costs in addition to capital costs.

Table 8-32. Preliminary Cost Estimate for Alternative 8c: On-Site Disposal of Tailings and Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap

Task	Quantity	Units	Unit $	Cost $	Comment
Mobilization, Bonding & Insurance	1	L.S.	274,028	$274,028	8%
Logistics					
Access Road Improvements	26,800	LF	1.00	$26,800	
Site Clearing/Preparation	31.20	Ac	2,000	$62,400	
Dog Creek Stream Diversions	6,700	LF	25.00	$167,500	
Unnamed Tributary Stream Diversion	600	LF	25.00	$15,000	
Dewater Ponds	1	LS	10,000	$10,000	
Debris Removal and Onsite Disposal	1	LS	15,000	$15,000	
Repository Construction					
Cover Soil Removal and Stockpiling	53,100	CY	2.00	$106,200	
Repository Base Grading	8.27	Ac	2,000	$16,540	
Waste Load, Haul & Dump					
Tailings	70,650	CY	10.00	$706,500	
Dog Creek Floodplain Tailings	7,510	CY	12.00	$90,120	
Impacted Soil	33,830	CY	10.00	$338,300	
Bald Butte Waste Rock	2,874	CY	10.00	$28,740	
Devon/Sterling and Albion Waste Rock	32,940	CY	9.00	$296,460	
Waste Grading and Compaction	147,804	CY	2.00	$295,608	
Repository Cap Construction					
Install Geotextile Cushion	40,140	SY	3.00	$120,420	
Geosynthetic Clay Liner	40,140	SY	4.50	$180,630	
Geocomposite Drainage Layer	40,140	SY	4.50	$180,630	
Cover Soil	26,400	CY	2.00	$52,800	
Stream Channel Reconstruction	7,100	LF	80.00	$568,000	
Water Diversion/Runon Controls					
Run-on Control Ditch	1,000	LF	2.00	$2,000	
Adit Discharge Infiltration Gallery	1	LS	10,000	$10,000	
Grade Native Soil Dams	7,200	CY	2	$14,400	
Revegetation					
Seed/Fertilize	31.20	Ac	1,000	$31,200	
Mulch	31.20	Ac	1,000	$31,200	
Fencing					
Barbed-wire Fence	17,200	LF	2.50	$43,000	
Repository Fence	2,650	LF	6.00	$15,900	
Subtotal				$3,699,376	
Construction Oversight	15%			$554,906	
Subtotal Capital Costs				$4,254,282	
Contingency	10%			$425,428	
TOTAL CAPITAL COSTS				$4,679,711	
POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	1	/Year	250	$250	
Sampling & Analysis	4	/Year	200	$800	
Maintenance	1	L.S.	1500	$1,500	
Subtotal				$2,550	
Contingency	10%			$255	
TOTAL ANNUAL O&M COST				$2,805	
TOTAL CAPITAL COSTS				$4,679,711	
PRESENT WORTH O&M COST	30	yrs @	10%	$26,442	
TOTAL PRESENT WORTH COST				$4,706,153	

Conceptual Design and Assumptions

The repository would be constructed approximately 1.5 miles northeast of the Bald Butte millsite on public land administered by the Bureau of Land Management. The repository would be used to contain wastes from both the Bald Butte Mine and Millsite and the Great Divide Tailings Site. The repository site was selected because it is located on BLM land, is strategically located between the two sites, has favorable topography and drainage conditions, and has sufficient cover soil to accommodate both projects. Two alternative sites on nearby BLM land were also considered, but they did not meet the project requirements because of shallow bedrock, lack of cover soil, and/or unfavorable size or topography. The site selected for the repository is an open hill side that slopes gently to the southeast. The proposed location is largely devoid of trees and a test pit investigation confirmed that the location contains an adequate volume of cover soil. Because the proposed repository site is located along the top of the Continental Divide, there is a possibility that shallow outcrops may be present within the repository area. In addition, there may be some trees, stumps, and several abandoned power poles that would require removal to facilitate repository construction. The conceptual design of the repository is shown on Figure 3-11. The repository is designed to accommodate a waste volume of approximately 230,000 cubic yards, which includes 150,000 cubic yards of waste and impacted soil from the Bald Butte mine and millsite, 40,000 cubic yards of mine/mill waste from the Great Divide Tailings Site, and a 20 percent volume contingency of 40,000 cubic yards.

A considerable amount of heavy equipment/machinery would be necessary to efficiently implement these alternatives. To construct the repository and load out the waste material, as well as construct runon/runoff control structures, equipment requirements would include, but not be limited to, multiple bulldozers, front end loaders and excavators. Haul trucks or scrapers would also be required to transport and deposit the contaminated material in the constructed repository. The field procedure would involve improving the existing roads from the tailings and waste rock pile areas to the repository area to a one lane haul road with turnouts to allow unobstructed access for heavy equipment. The number of loaders, haul trucks and/or scrapers would be maximized to the extent possible to reduce the overall time required to complete the project's construction phase.

Removal of the Bald Butte millsite tailings piles would require the construction of temporary diversions of Dog Creek around tailings piles TP-1, TP-2 and TP-3; tailings pile TP-5; and tailings pile TP-6 to facilitate the removal of tailings. After the repository construction, waste excavation, and waste placement are complete, the excavated areas would be revegetated. Cover/fill soil may be required in the excavated areas to level and contour the areas to match the surrounding terrain. It is assumed that soil from the repository excavation would be stockpiled and used for cover soil on the repository. Approximately 12,000 cubic yards of cover soil would be designated for use at the Great Divide Tailings Site. Native soil from the TP-1 and TP-2 dams would be graded onto the excavated source areas prior to revegetation. It is possible that a pond could be reconstructed in the area of the existing Pond 2 (Figure 3-2) to continue the current level of recreational opportunities. If a pond is reconstructed, the native soil from the TP-1 and TP-2 dams would be used to construct the pond dam.

The seed beds would be prepared using conventional agricultural plowing. Seeding would likely take place during the fall of the year. The seed mixture and fertilizer would be applied simultaneously to the prepared seed beds via drill application. Mulch would be applied to promote temporary protection of exposed erodible surfaces. Wheat or barley straw mulch (certified weed-free) would be applied over the excavated areas and the repository cap with a tow spreader or pneumatic spreader utilizing tucking/crimping as the anchoring mechanism. A runon/runoff control ditch would be constructed in the area of the repository to divert runoff away from the repository cap. Barbed-wire fencing would be placed around the excavated waste source areas to allow the establishment of vegetation without interference from livestock. A woven-wire fence would be constructed around the repository to limit access.

The general construction steps for implementing Alternative 8c are as follows:

- improving access roads from the waste source areas to the repository;
- site clearing, preparation and debris removal;
- dewatering of the two ponds in the vicinity of tailings pile TP-1 to facilitate tailings removal and site reclamation;
- preparation of the repository base, including tree, stump and rock removal and recovery and stockpiling of cover soil;
- excavation, loading, hauling, placement, grading and compaction of tailings from tailings piles TP-1 through TP-6;
- excavation, loading, hauling, placement, grading and compaction of impacted native soils from beneath tailings area;
- excavation, loading, hauling, placement, grading and compaction of waste rock from waste rock piles WR-1 through WR-4 and WR1A through WR3A;
- installation of the cap liners and geocomposite drainage layer;
- placement and grading of stockpiled cover soil on the repository;
- constructing surface water diversion ditches strategically located to control water runon in the vicinity of the repository;
- reconstruction of the Dog Creek stream channel in the vicinity of tailings piles TP-1 through TP-6;
- grading of native soil from the TP-1 and TP-2 dams onto the excavated source areas;
- reconstruction of the unnamed tributary of Dog Creek through a portion waste rock pile WR1A;
- diversion of adit discharge water to a subsurface infiltration gallery to eliminate exposure by direct contact;
- establishing vegetation on the repository and excavated waste area by seeding and fertilizing;
- mulching of the seeded areas;
- constructing a 4-strand, barbed-wire fence around the perimeter of the excavated source areas; and

- construction of a woven-wire fence around the repository.

9.0 Comparative Analysis of Reclamation Alternatives

This section provides a comparison of the reclamation alternatives retained for the Bald Butte Millsite and Devon/Sterling and Albion Mines project. The comparison focuses mainly on the following criteria: 1) the relative protectiveness of human health and the environment provided by the alternatives; 2) the long-term effectiveness provided by the alternatives; and 3) the estimated attainment of ARARs for each alternative. Qualitative comparisons are used to contrast the two threshold criteria of "overall protection of human health and the environment" and "compliance with ARARs" for each alternative. The primary balancing criteria are also compared, although, the evaluation of each of these criteria is very similar due to the technical similarities in the alternatives themselves, with the exception of costs. Table 9-1 presents a summary of the alternatives with respect to the first eight evaluation criteria.

Alternative 1 - No Action is not considered any further for this alternative would not address any of the environmental concerns raised for the site and would not meet contaminant-specific ARARs.

Alternative 3, which addresses waste rock only at the Devon/Sterling and Albion Mines, is not considered to be a stand-alone reclamation alternative. This alternative would provide for partial removal of waste rock pile WR1A and removal of WR3A so that they are no longer in contact with the unnamed tributary to Dog Creek. Alternative 3 does not provide any significant reduction in exposure risk for the contaminants identified at the site, however, the risk assessment (Section 5) shows that the waste rock piles do not pose a significant risk to human health. However, in-place containment of waste rock could be an attractive alternative when used in conjunction with another alternative.

Alternatives 3, 4a, 4b, 4c, 7a, 7b, 7c, 8a, 8b, and 8c are expected to achieve compliance with action-specific and location-specific ARARs, however, while these alternatives significantly reduce the risks associated with surface water, none of them are expected to satisfy all surface water quality ARARs. None of the alternatives are expected to meet surface water quality ARARs because the chronic aquatic life standard for lead is exceeded in Dog Creek above the site and in the unnamed tributary to Dog Creek above the Devon/Sterling and Albion Mines. Additionally, drinking water ARARs are exceeded for manganese in Dog Creek above the site and in the unnamed tributary to Dog Creek above the Devon/Sterling and Albion Mines. When comparing the exposure pathways of direct contact, surface water and air, each of these alternatives provide similar short-term risk reduction for the contaminants at the site. Alternatives 7a, 7b, 7c, 8a, 8b, and 8c would provide the greater long-term protection of human health and the environment because of the location of the repository away from the stream drainage and the placement of all wastes in an engineered repository. Alternative 3 is not considered a stand-alone alternative and would be implemented in conjunction with Alternative 4a, 4b or 4c. Alternatives 4a, 4b and 4c would provide for the placement of all tailings associated with the project, as well as the Bald Butte Millsite waste rock and a portion of the Devon/Sterling and Albion Mines waste rock in an engineered repository. Alternatives 8a, 8b, and 8c would provide greater long-term protection of human health and the environment, particularly water resources, because the repository is located in a more favorable location near the top of the Continental Divide. This location is farther away from surface water resources and is also located farther above the ground water table.

Table 9-1. Comparative Analysis of Alternatives

Assessment Criteria	Alternative 1: No Action	Alternative 3: Partial In-Place Containment of Devon/Sterling and Albion Waste Rock	Alternative 4a: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed RCRA Repository	Alternative 4b: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed Modified RCRA Repository
Overall Protection of Public Health, Safety and Welfare -	No reduction in risk.	Containment and stabilization of waste rock sources is not expected to reduce human exposure risk as a stand-alone alternative.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.
Environmental Protectiveness	No protection offered.	Containment and stabilization of waste rock sources is not expected to reduce human exposure risk as a stand-alone alternative.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.
Compliance with ARARs -				
Contaminant Specific	Would not be met.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.
Location Specific	None apply.	Location-specific ARARs would be met.	Location-specific ARARs would be met.	Location-specific ARARs would be met.
Action Specific	None apply.	Action-specific ARARs would be met, except waste rock would be left unvegetated.	Action-specific ARARs would be met.	Action-specific ARARs would be met.
Long-Term Effectiveness and Performance -				
Magnitude of Risk Reduction	No reduction in CoCs in any environmental media, except by natural degradation/erosion.	Minor reduction in CoCs as a stand-alone alternative except by natural degradation.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.
Adequacy and Reliability of Controls	No controls over any on-site contamination, no reliability.	Minimal as a stand-alone alternative, some reduction via natural revegetation on waste rock piles.	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.
Reduction of Toxicity, Mobility and Volume -				
Treatment Process Used and Materials Treated	None	No treatment, however, removal of waste rock from unnamed tributary to Dog Creek will reduce mobility of CoCs.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.
Volume of Contaminated Materials Treated	No reduction in CoC toxicity, mobility or volume.	No volume actively treated, however, 6,690 cubic yards of waste rock would be removed from the unnamed tribnutary and isolated in the repository.	No volume actively treated, however, 114,864 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 114,864 cubic yards of tailings and waste rock would be removed and isolated in the repository.
Expected Degree of Reduction	Minimal, via natural degradation only (potential for future increases in mobility of contaminants)	Minimal, via natural degradation only	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.
Short-Term Effectiveness -				
Protection of Community During Remedial Action	Not applicable.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.
Protection of On-Site Workers During Removal Action	Not applicable.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.
Environmental Impacts	Same as baseline conditions.	Environmental impacts possible due to waste rock excavation activities near unnamed tributary.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.
Time Until Removal Action Objectives are Achieved	Not applicable.	One construction season.	One construction season.	One construction season.
Implementability -				
Ability to Construct and Operate	No construction or operation involved.	Easily implementable.	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.
Ease of Implementing More Action If Necessary	Not applicable.	Steep slopes and limited space make more action complicated, although it is possible.	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.
Availability of Services and Capacities	Not applicable.	Available locally and within state.	Available locally and within state.	Available locally and within state.
Availability of Equipment and Materials	Not applicable.	Available locally and within state.	Available locally and within state.	Available locally and within state.
Estimated Total Present Worth Cost	**$0**	**$230,662**	**$3,843,869**	**$2,858,019**

Table 9-1. Comparative Analysis of Alternatives

Assessment Criteria	Alternative 4c: On-Site Disposal of Tailings and Selected Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap	Alternative 7a: On-Site Disposal of Tailings and Waste Rock in a Constructed RCRA Repository	Alternative 7b: On-Site Disposal of Tailings and Waste Rock in a Constructed Modified RCRA Repository	Alternative 7c: On-Site Disposal of Tailings and Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap
Overall Protection of Public Health, Safety and Welfare -	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.
Environmental Protectiveness	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.
Compliance with ARARs -				
Contaminant Specific	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.
Location Specific	Location-specific ARARs would be met.	Location-specific ARARs would be met.	Location-specific ARARs would be met.	Location-specific ARARs would be met.
Action Specific	Action-specific ARARs would be met.	Action-specific ARARs would be met.	Action-specific ARARs would be met.	Action-specific ARARs would be met.
Long-Term Effectiveness and Performance -				
Magnitude of Risk Reduction	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.
Adequacy and Reliability of Controls	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.
Reduction of Toxicity, Mobility and Volume -				
Treatment Process Used and Materials Treated	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.
Volume of Contaminated Materials Treated	No volume actively treated, however, 114,864 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.
Expected Degree of Reduction	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.
Short-Term Effectiveness -				
Protection of Community During Remedial Action	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.
Protection of On-Site Workers During Removal Action	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.
Environmental Impacts	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.
Time Until Removal Action Objectives are Achieved	One construction season.	One construction season.	One construction season.	One construction season.
Implementability -				
Ability to Construct and Operate	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.
Ease of Implementing More Action If Necessary	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.
Availability of Services and Capacities	Available locally and within state.	Available locally and within state.	Available locally and within state.	Available locally and within state.
Availability of Equipment and Materials	Available locally and within state.	Available locally and within state.	Available locally and within state.	Available locally and within state.
Estimated Total Present Worth Cost	**$2,639,973**	**$4,562,890**	**$3,461,938**	**$3,218,071**

Table 9-1. Comparative Analysis of Alternatives

Assessment Criteria	Alternative 8a: On-Site Disposal of Tailings and Waste Rock in a Constructed RCRA Repository Located On the continental Divide	Alternative 8b: On-Site Disposal of Tailings and Waste Rock in a Constructed Modified RCRA Repository Located On the continental Divide	Alternative 8c: On-Site Disposal of Tailings and Waste Rock in a Constructed Unlined Repository with a Multi-Layered Cap Located On the continental Divide
Overall Protection of Public Health, Safety and Welfare -	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.	Consolidation, encapsulation and stabilization of tailings and WR1-WR4 sources is expected to significantly to reduce human exposure.
Environmental Protectiveness	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.	Encapsulation and stabilization of tailings and WR1-WR4 sources is expected significantly to reduce overall ecological exposure.
Compliance with ARARs -			
Contaminant Specific	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.	Background for Mn in unnamed tributary exceed drinking water MCLs/HHS. Background for Pb in unnamed tributary exceeds CALs.
Location Specific	Location-specific ARARs would be met.	Location-specific ARARs would be met.	Location-specific ARARs would be met.
Action Specific	Action-specific ARARs would be met.	Action-specific ARARs would be met.	Action-specific ARARs would be met.
Long-Term Effectiveness and Performance -			
Magnitude of Risk Reduction	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.	High overall risk reduction is expected with tailings and WR1-WR4 removal from Dog Creek and placement in an engineered repository.
Adequacy and Reliability of Controls	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.	Primary sources of concern will be adequately isolated from human and environmental receptors.
Reduction of Toxicity, Mobility and Volume -			
Treatment Process Used and Materials Treated	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.	No treatment, however, removal and encapsulation of primary sources of concern from near Dog Creek is expected to provide significant reduction in mobility of CoCs for all pathways.
Volume of Contaminated Materials Treated	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.	No volume actively treated, however, 147,804 cubic yards of tailings and waste rock would be removed and isolated in the repository.
Expected Degree of Reduction	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.	Volume or toxicity of wastes would not be reduced, however, mobility of CoCs would be significantly reduced.
Short-Term Effectiveness -			
Protection of Community During Remedial Action	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.	Fugitive emissions control may be required during construction. Minimal impact on community with the exception of increased vehicle traffic on on-site roads.
Protection of On-Site Workers During Removal Action	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.	Expected to be sufficient. Safety hazards likely more prevalent than hazards associated with wastes.
Environmental Impacts	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.	Environmental impacts possible due to tailings and waste rock excavation activities near stream.
Time Until Removal Action Objectives are Achieved	Two or three construction season.	Two or three construction season.	Two or three construction season.
Implementability -			
Ability to Construct and Operate	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.	Easily implementable. Liner installation will require intensive construction QA/QC.
Ease of Implementing More Action If Necessary	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.	Easily implementable if additional armoring or stabilization, etc. determined necessary.
Availability of Services and Capacities	Available locally and within state.	Available locally and within state.	Available locally and within state.
Availability of Equipment and Materials	Available locally and within state.	Available locally and within state.	Available locally and within state.
Estimated Total Present Worth Cost	**$6,968,034**	**$5,115,423**	**$4,706,153**

None of the alternatives reduce the toxicity or volume of the contaminants of concern. The objective of the alternatives is to sever the exposure pathway and to limit the mobility of the contaminants. Limiting contaminant mobility will achieve protection of human health and the environment and will meet applicable ARARs identified for the site.

The short-term effectiveness is expected to be, for the most part, similar to each of the action alternatives. The alternatives are all technically similar and the construction steps required to implement them are expected to be accomplished in two or three field construction seasons of generally less than 120 days each. Risk exposure to the community is expected to be minimal, with the exception of increased traffic on the roads in the vicinity of the waste sources and the repository.

On-site workers will be required to have hazardous materials handling training and will be subject to a site specific Health and Safety Plan for their protection. Tailings and waste rock excavation activities in or near the Dog Creek stream channel and floodplain may have some short term impact to the environment, although efforts will be made to minimize the risk by temporary stream diversion. Because each of the alternatives will involve excavation and haulage of significant volumes of tailings or waste rock, localized air quality impacts may occur from fugitive dust emissions. Water sprays will be used to control dust emissions and to minimize dust exposure.

For ease of construction, Alternative 4c implemented in conjunction with Alternative 3 would probably be the easiest alternative to implement because the steepest waste rock at the Devon/Sterling and Albion Mines would be contained in place under Alternative 3 and the repository lining requirements are less than under Alternatives 4a, 4b, 7a, 7b, 8a and 8c. Alternatives 7a, 7b, 8a, and 8b would be the most technically difficult to implement because of the steepness of the Devon/Sterling and Albion Mine waste rock piles, the increased waste volume to move, the increased haul distance for the waste disposal, and the increased construction quality control for repository construction. Alternatives 8a and 8b have a significantly longer haul distance and corresponding larger cost than alternatives 7a and 7b. Implementation of Alternative 7c would be similar to Alternatives 7a and 7b, except that the liner requirements would be reduced because no base liner would be installed. Similarly, implementation of Alternative 8c would be similar to Alternatives 8a and 8b, except that the liner requirements would be reduced because no base liner would be installed. Alternatives 4a and 4b would be similar to the implementation of Alternative 4c, except that the lining requirements would be more stringent than Alternative 4c.

Due to the large-scale nature of this reclamation project, in conjunction with the technical requirements applicable to installing surface water diversions, heavy equipment operation and grading requirements, only properly trained and experienced contractors/crews utilizing large-capacity equipment should perform the specified work. Small capacity equipment and/or inexperienced contractors and crews would likely prolong the construction phase and may result in increased costs and compromised performance.

Table 9-1 indicates the estimated total costs associated with each alternative. The no action alternative is not considered feasible because it would not adequately address the identified risks to human health and the environment at the site. Alternative 3 is not considered a stand-alone alternative and would be implemented in conjunction with Alternative 4a, 4b or 4c. Of the various action alternatives considered for the site, Alternative 3 is the least costly, and Alternative 7a is the most costly. To compare on an equal basis, the cost of Alternative 3 has been added to the costs of 4a, 4b and 4c for comparison with alternatives 7a, 7b, 7c, 8a, 8b, and 8c. The combined estimated costs for Alternative 3 with Alternatives 4a, 4b and 4c are $4,074,530, $3,088,681 and $2,870,635, respectively. Estimated costs for Alternatives 7a, 7b and 7c are $4,562,890, $3,461,938 and $3,218,071, respectively. Estimated costs for Alternatives 8a, 8b and 8c are $6,968,034, $5,116,423, and $4,706,153, respectively. Direct cost comparisons can be made between Alternatives 3/4a and 7a, Alternatives 3/4b and 7b and Alternatives 3/4c and 7c. The estimated cost for Alternative 7a is $488,360 more than the combined Alternatives 3 and 4a. The estimated cost for Alternative 7b is $373,257 more than the combined Alternatives 3 and 4b. The estimated cost for Alternative 7c is $347,436 more than the combined Alternatives 3 and 4c. The cost differences between Alternatives 7a and 8a, 7b and 8b, and 7c and 8c are due to the increased haul distance (approximately 2.5 miles) and increased liner cost because of a larger repository area associated with Alternative 8 versus Alternative 7. The estimated cost for Alternative 8a is $2,405,144 more than Alternative 7a. The estimated cost for Alternative 8b is $1,654,485 more than Alternative 7b. The estimated cost for Alternative 8c is $1,488,082 more than Alternative 7c.